MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2022/2023 (TERM ID 2210)

DBM5114 – BUSINESS MATHEMATICS

(All Sections/Groups)

13 FEBRUARY 2023
9.00 am – 11.00 am
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consist of **FIVE (5)** pages (excluding the cover page).

2. Answer **ALL** questions. The marks distributions are given in parentheses.

3. The Formulae Sheet is provided at the end of pages.

QUESTION 1 [25 MARKS]

a) Simplify the following expression and give the answer in positive exponent:

$$\frac{(x^2y^{-3}z^4)^5}{(x^{-1}z^{-2})^{-3}}$$

[5 marks]

b) Solve the following inequalities:

i. $\frac{5x+2}{4} \leq 2x - 1$ **[3 marks]**

ii. $2 < 3x - 8 < 8$ **[3 marks]**

c) Given a straight line $L: y = 3x - 5$. Find an equation of the straight line that is:

i. Parallel to L and passing through (4, -5) **[5 marks]**

ii. Perpendicular to L and passing through (2,1) **[5 marks]**

d) Given cost and revenue functions: $C(x) = 5x + 25$ and $R(x) = 10x$, respectively. Find:

i. profit function **[2 marks]**

ii. break-even point **[2 marks]**

QUESTION 2 [25 MARKS]

a) Find the amount of an ordinary annuity of 60 monthly payment of $450 that earns interest at a rate of 12% per year compounded monthly. **[4 marks]**

b) Harry and Megan have $100,000 for a down payment and their budget can accommodate a monthly mortgage payment of $4500. What is the most expensive home, they can buy if they can borrow money for 35 years at 9%, compounded monthly? **[6 marks]**

Continued...

c) Given a linear programming as below:

$$\text{Minimize } Z = 20x + 30y$$

Subject to:

$$2x + y \leq 10$$
$$3x + 4y \leq 24$$
$$x, y \geq 0$$

Solve the above linear programming using graphical method.
State the optimal solution. **[15 marks]**

QUESTION 3 [25 MARKS]

a) Compute the required matrices given that:

$$A = \begin{bmatrix} 1 & -2 \\ 0 & 3 \end{bmatrix} \qquad B = \begin{bmatrix} -2 & 3 & 0 \\ 1 & -4 & 1 \end{bmatrix} \qquad C = \begin{bmatrix} 3 & 0 & 0 \\ 0 & 6 & 0 \\ 0 & 0 & 3 \end{bmatrix}$$

i. Inverse of A **[4 marks]**

ii. BC **[6 marks]**

b) Solve the following system of equation using Cramer's rule:

$$x + 3y + 3z = 7$$
$$2x + y + 2z = 4$$
$$x + y + 2z = 3$$

[15 marks]

QUESTION 4 [25 MARKS]

a) Find the derivative of the following functions:

i. $f(x) = 7 + 8x^2 + 3x^3$ **[2 marks]**

ii. $f(x) = (2x + 7)(x - 9)$ **[6 marks]**

b) A firm sold a product at RM25 and the total cost per month is given by $C(x) = 150 + 0.02x^2$ where x is the units of a product per month. Find:

i. The total profit function **[2 marks]**

ii. The marginal profit function **[3 marks]**

iii. The marginal cost function **[2 marks]**

iv. The marginal cost when 50 units are produced **[2 marks]**

c) Evaluate $\int_2^3 (x + 2)^2 \, dx$ **[8 marks]**

End of questions.

APPENDIXES:

A. LINEAR FUNCTIONS

Cost, Revenue and Profit Functions

Total Cost ($C(x)$) = Variable cost + Fixed cost
Total Revenue ($R(x)$) = Price per unit X Quantity Sold
Profit ($P(x)$) = $R(x) - C(x)$

Break-even Analysis: $R(x) = C(x)$

B. MATRICES

Inverse of a 2 × 2 matrix

$$\text{If } A=\begin{bmatrix} a & b \\ c & d \end{bmatrix}, \text{ then } A^{-1}=\frac{1}{ad-bc}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}, \text{ where } ad-bc\neq 0.$$

Determinant of a 3 × 3 matrix

$$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = a_1\begin{vmatrix} b_2 & c_2 \\ b_3 & c_3 \end{vmatrix} - b_1\begin{vmatrix} a_2 & c_2 \\ a_3 & c_3 \end{vmatrix} + c_1\begin{vmatrix} a_2 & b_2 \\ a_3 & b_3 \end{vmatrix}$$

$$|A| = a_{11}c_{11} + a_{12}c_{12} + a_{13}c_{13}$$

Cramer's Rule for 3 × 3 matrix

$$a_1x + b_1y + c_1z = d_1$$
$$a_2x + b_2y + c_2z = d_2$$
$$a_3x + b_3y + c_3z = d_3$$

$$\text{then } x=\frac{D_x}{D}, y=\frac{D_y}{D}, z=\frac{D_z}{D} \text{ where}$$

$$D=\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix},\ D_x=\begin{vmatrix} d_1 & b_1 & c_1 \\ d_2 & b_2 & c_2 \\ d_3 & b_3 & c_3 \end{vmatrix},\ D_y=\begin{vmatrix} a_1 & d_1 & c_1 \\ a_2 & d_2 & c_2 \\ a_3 & d_3 & c_3 \end{vmatrix},\ D_z=\begin{vmatrix} a_1 & b_1 & d_1 \\ a_2 & b_2 & d_2 \\ a_3 & b_3 & d_3 \end{vmatrix}$$

C. BASIC RULES OF DIFFERENTIATION

(i) Constant, $f(x) = c$: $f'(c) = 0$

(ii) Power rule, $f(x) = x^n$: $f'(x) = nx^{n-1}$

(iii) Constant multiple a function, $cf(x)$: $cf'(x)$

(iv) Sum or difference rule, $f(x) \pm g(x)$: $f'(x) \pm g'(x)$

(v) Product rule, $f(x) = u.v$: $f'(x) = uv' + vu'$

(vi) Quotient rule, $f(x) = \frac{u}{v}$; $f'(x) = \frac{vu' - uv'}{v^2}$

(vii) Chain rule: Derive $g[f(x)] = g'[f(x)]f'(x)$

(viii) General power rule: Derive $[f(x)]^n = n[f(x)]^{n-1} f'(x)$

(ix) Exponential function:

$f(x) = e^x$; $f'(x) = e^x$

$f(x) = e^{f(x)}$; $f'(x) = e^{f(x)}f'(x)$

(x) Logarithmic function:

Derive $\ln x = \frac{1}{x}$

Derive $(\ln u(x)) = \left(\frac{1}{u(x)}\right)[u'(x)]$

D. INTEGRATION

Basic Rules of Integration

(i) $\int k\, dx = kx + C$

(ii) $\int x^n\, dx = \frac{x^{n+1}}{n+1} + C$

(iii) $\int kf(x)\, dx = k \int f(x) dx$

(iv) $\int (f \pm g)(x) = \int f(x) dx \pm \int g(x) dx$

(v) $\int e^x dx = e^x + C$

(vi) $\int \frac{1}{x}\, dx = \ln x + C$

Application of Integrals:

Areas Between Curves

$$A = \int_a^b [f(x) - g(x)] dx$$

E. FINANCIAL MATHEMATICS

Simple Interest

Interest: $I = \Pr t$

Accumulated amount: $A = P(1+rt)$

Compounded Interest

Accumulated amount: $A = P(1+i)^n$

Present Value: $P = A(1+i)^{-n}$

Interest: $I = P(1+i)^n - P$

Effective rate of interest

$$r_e = \left(1+\frac{r}{m}\right)^m - 1$$

Sinking Fund

$$R = \left[\frac{Si}{(1+i)^n - 1}\right]$$

Amortization

$$R = \left[\frac{Pi}{1-(1+i)^{-n}}\right]$$

Future Value of an Annuity

$$A = R\left[\frac{(1+i)^n - 1}{i}\right]$$

Present Value of an Annuity

$$P = R\left[\frac{1-(1+i)^{-n}}{i}\right]$$

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